

R E M A R K S

Reconsideration of this application, as amended, is respectfully requested.

THE CLAIMS

Claims 1, 3, 4, 7 and 9-20 have been amended to recite an electrostatic attraction type liquid ejection apparatus, as supported by the disclosure in the specification at, for example, page 45, lines 17 to 21. In addition, the claims have been amended to make some minor grammatical improvements and to correct some minor antecedent basis problems so as to put them in better form for issuance in a U.S. patent.

No new matter has been added, and it is respectfully requested that the amendments to the claims be approved and entered.

THE PRIOR ART REJECTION

Claims 1, 3, 4, 7 and 9-20 were rejected under 35 USC 103 as being obvious in view of the combination of USP 5,477,249 ("Hotomi"), USP 6,382,754 ("Morikoshi et al"), and USP 6,017,112 ("Anderson et al"). These rejections, however, are respectfully traversed with respect to the claims as amended hereinabove.

The present invention relates to a liquid ejection apparatus that ejects liquid on to a substrate. Specifically, as recited in amended independent claim 1, an electrostatic attraction type liquid ejection apparatus (20) is provided which comprises: a liquid ejection head (26) having a nozzle (21) with an inner diameter of at most 15 μm ; an ejection voltage supply (25) to apply an ejection voltage to a solution inside the nozzle (21) so as to charge the solution, the ejection voltage supply including an electrode (28) which contacts with the solution to charge the solution; and a convex meniscus generator (40) to cause the solution inside the nozzle (21) to rise from the nozzle (21) in a convex shape.

In addition, according to the present invention as recited in independent claim 1, an operation controller (50) is provided to control application of a drive voltage to drive the convex meniscus generator (40) and application of the ejection voltage by the ejection voltage supply (25) so that the drive voltage to the convex meniscus generator is applied in a timing corresponding to the application of a pulse voltage as the ejection voltage by the ejection voltage supply (25), wherein the operation controller (50) controls a voltage having a reversed polarity to the ejection voltage to be applied by the electrode (28) to the solution inside the nozzle (21) just before or just

after the ejection voltage is applied to the solution inside the nozzle (21). See Fig. 1 of the present application.

With this structure, since the operation controller applies a voltage with reversed polarity just after the ejection voltage is applied to the ejection electrode, an electro-wetting effect can be cancelled along with the excessive concentration of particle substances in the solution at the top portion side of the nozzle, and the influence on charge-up, which are caused by application of the ejection voltage, and the next ejection can be appropriately maintained. See, for example, the disclosure in the specification at page 40, lines 18-26.

On pages 3 and 4 of the Office Action, the Examiner asserts that Figs. 1 to 3 of Hotomi disclose a liquid ejection apparatus corresponding to the liquid ejection apparatus of the claimed present invention.

It is respectfully pointed out, however, that according to the present invention as recited in amended independent claims 1, the liquid ejection apparatus is actually an electrostatic attraction type liquid ejection apparatus. And it is respectfully submitted that Hotomi merely discloses an apparatus for forming liquid images onto an image carrier, and that it would not have been obvious to apply voltage control to the apparatus disclosed in Hotomi.

In any event, on page 4 of the Office Action, the Examiner acknowledges that Hotomi does not disclose an operation controller that controls the application of a voltage having reversed polarity to the ejection voltage to be applied by the electrode to the solution inside the nozzle just before or just after the ejection voltage is applied to the solution inside the nozzle, in the manner of the present invention. For this reason, the Examiner has cited Morikoshi et al as disclosing the missing features of Hotomi.

Morikoshi et al teaches an ink jet printing device comprising a driving-pulse control means (130) for controlling a piezoelectric vibrator (9) of the device by sending pulse signals (P1; P2; P3) to the vibrator. The piezoelectric vibrator expands and contracts the pressure generating chamber (3) which has a nozzle (2), and causes ink drops to be discharged from the nozzle during contraction. See, for example, Figs. 1 and 23 of Morikoshi et al.

It is respectfully pointed out that the pulse signals described by Morikoshi et al sent to the piezoelectric vibrator do not oscillate between negative and positive voltages. Specifically, Morikoshi et al recites that a pulse width (pw2) is required to discharge the piezoelectric vibrator up to zero-voltage. That is, the amplitude of the pulse (S1) does not start

from zero-voltage and the driving pulse becomes zero at (pwh2) period where the voltage is the lowest. See, for example, Fig. 24(a) and column 18, line 18 of Morikoshi et al.

Because of this, it is respectfully pointed out that in Morikoshi et al, the driving pulse always has a positive voltage and cannot be negative. That is, the driving pulse never reverses its polarity.

It is respectfully submitted, therefore, that unlike as according to the present invention as recited in independent claim 1, Morikoshi et al does not disclose, teach or suggest an operation controller which controls a voltage having a reversed polarity to the ejection voltage to be applied by the electrode to the solution inside the nozzle just before or just after the ejection voltage is applied to the solution inside the nozzle.

Accordingly, it is respectfully submitted that even if Hotomi and Morikoshi et al were combinable in the manner suggested by the Examiner, the structure of the present invention as recited in amended independent claim 1 would still not be achieved or rendered obvious.

In view of the foregoing, it is respectfully submitted that amended independent claim 1, and claims 3, 4, 7 and 9-20 depending therefrom, all clearly patentably distinguish over the cited references under 35 USC 103.

Entry of this Amendment, allowance of the claims and the passing of this application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

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